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1994 Feature Article - Labour Force Participation Rate Projections to 2011

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INTRODUCTION

Labour force projections such as the recently published Labour Force Projections, Australia 1995-2011 (ABS cat no. 6260.0 can be used in a variety of settings, including economic modelling exercises, policy forums, marketing strategies and government and business planning processes. The usefulness of the projections depends on their accuracy. An effective way to evaluate projections is with hindsight. However, as the projections have only been produced for a short period of time this technique can not be used This article uses an alternative method for assessing the projections based on an examination of the assumptions and method that underpin the analysis.

Labour force projections are derived from the combined effect of labour force participation rate projections and population projections. This article focuses on the participation rate projections by outlining the methodological basis of the projections, analysing each age group or cohort, and drawing attention to interesting features **(footnote 1)**. A second article, appearing soon in AEI, will examine the combined effect of the participation rate projections and the latest ABS population projections.

BACKGROUND

Labour force projections were first published by the ABS in 1991. These projections relied almost exclusively upon simple time-trend regression techniques to project participation rates for 16 age-by-sex cohorts to the year 2005. A similar approach was adopted for the latest labour force projections, which extend to the year 2011 . While the precise techniques have been modified, the time-trend regression methods are still preferred **(footnote 2)**.

THE DATA

Monthly participation rates, for 16 age-by-sex cohorts, for the period 1978 to 1993 were selected for analysis. Despite the existence of similar quarterly time series dating back to the mid-1960s, the monthly data were considered more suitable for two reasons.

Firstly, the longer term institutional developments which have significantly influenced the growth in female participation rates did not emerge until the late 1970s. The earlier data may therefore contain little relevant information for the purpose of producing projections.

Secondly, the quarterly data are not average rates calculated for the quarter, but rather the monthly rates pertaining to the mid-months of the quarters

(February, May, August and November). Participation rates display strong seasonality, and consequently different choices of the representative month for the quarter (first month/mid-month/ final month) can result in significantly different levels of the derived time series. This is unsatisfactory for the purposes of this study, as the projected trends may be unrepresentative of the more complete time series.

THE METHODOLOGY

Three basic methods were used in combination to project participation rates for the various cohorts.

(1) **Constant rates:** assuming that the participation rate will remain at a constant level for future periods. This is perhaps the simplest technique for extrapolating participation rates. The technique is most suitable either for very stable participation rates, or for cases where the data are highly irregular and no sensible trend can be readily detected.

(2) **Linear trends:** fitting a linear trend to the participation rates, using the ordinary least squares (OLS) regression technique, and then extrapolating the estimated linear trend. Linear trends are commonly used to extrapolate participation rates which are well behaved and have changed only gradually over time. Clearly linear trends cannot be extrapolated in-definitely, since participation rates are bounded above and below by 100% and 0%, respectively. It is important that the participation rates at the end of the forecast period be plausible and justifiable.

(3) **Logistic trends:** fitting a logistic trend to the participation rates, using a non-linear least squares (NLLS) method, and extrapolating the fitted trend. Logistic trend extrapolation involves fitting the regression equation

$$p_t = 1 / (k + ab^T) + e_t$$

where

p_t is the participation rate in time period t;
T is a linear time trend;
e_t is the residual in time period t; and
a, b, k are the parameters to be estimated.

It can be seen from the equation that, provided $b < 1$,

$$p_t \rightarrow 1/k \text{ as } T \rightarrow \infty.$$

That is, the logistic trend converges asymptotically to the value 1/k. The logistic regression may be fitted to either increasing or decreasing data, and is particularly suitable for data which display indications of tapering growth rates, and/or are defined to lie within a specified range of values (for example, 0 to 1).

It may also happen that theoretical or empirical results suggest that the extrapolated trends should tend towards pre-determined maximum or minimum rates. In this instance, the appropriate value of k may be inserted in the equation, and there is then no need to estimate that parameter.

The non-linear least squares estimation technique may be adapted to allow simultaneous estimation of male and female participation rates within the same age cohort. If the two logistic trends are constrained to have a common value of k, then it can be seen that the extrapolated trends will converge to the same rate. This approach has been useful in cases where, otherwise, the projected female participation rates would exceed the male rates within the time horizon of the projections.

STAGES IN ASSESSING EACH AGE COHORT

For each cohort, the appropriate participation rate projection method was determined in the following manner:

Ordinary least squares regression techniques were used to fit a linear time trend to the data. If the extrapolated linear trend was found to be inappropriate - because of unusual cross-sectional features of the data, significant divergence from international experience or because it conflicted with generally-accepted expectations - an alternative trend was derived. Depending on the characteristics of the data, either a constant rate was assumed, or a logistic time trend was fitted.

Examples of the generally accepted expectations referred to in the previous paragraph include:

(i) female participation rates should not exceed male participation rates within any given age cohort;

(ii) differences between consecutive age cohorts should be within reasonable limits, and should be explicable.

Statistical criteria were also used in the assessment process - in particular, measures of the goodness of fit of the respective trend estimates assisted in the choice of projection method. Where the data indicated a period of significant stabilisation or an abrupt change of trend behaviour within the estimation period, attempts were made to modify the trend estimates and resulting projections accordingly.

International comparisons (most commonly with the United States and the United Kingdom) were used to assess alternative sets of projections. While keeping in mind the difficulties of comparing projections pertaining to different labour markets with different institutional features, these comparisons lent consistent support to the projected changes in the composition of the Australian labour market produced by the final choice of projections.

Life cycle profiles of labour force participation were a useful assessment tool, giving an effective means of checking that the differences between consecutive age cohort projections were within reasonable bounds. Life cycle profiles were used to assess the full implications of the projections upon average life time labour force participation.

LIMITATIONS OF THE METHODOLOGY

There are clearly limitations to the present methods employed to project participation rates. For this reason it is worth repeating the warning sounded in 1991 Labour Force Projections, Australia (cat. no. 6260.0) - “there is no rigorous and coherent theoretical background” to the method chosen. Also, “projections of trend only provide a scenario which may be realised if the necessarily arbitrary assumptions about participation rates eventuate.”

ANALYSIS BY COHORT

As stated above, assessment of the participation rates for each cohort began with an examination of the fitted linear trends. Comparisons were then made with the corresponding age cohort for the opposite sex, and with the contiguous age cohorts for the same sex. Alternative formulations for the trend projections were then considered as required. Following is a summary of the analysis for each cohort.

15-19 Years Old

The linear trend results for this age cohort show male participation rates to be declining faster than female rates. The results suggest, therefore, that female participation rates will shortly exceed male rates, and that the difference will continue indefinitely. This scenario appears improbable.

There is no identifiable reason why male and female rates for this age cohort should differ. When examining the male data, two features emerge which might justify our action to modify the male trend. Firstly, the period 1978 to 1982 was an unusually high period of participation for 15-19 males **(footnote 3).** Therefore, when a linear trend is derived on monthly data beginning in 1978 the derived trend is significantly affected by this period. The second feature which leads us to adjust the male trend is the observation that male and female rates have closely approximated each other in recent times and it seems likely that this trend will continue (see Chart 1).

Charts 1 to 8: Labour Force Participation Rate Projections, Fitted Trends, and Seasonally Adjusted Estimates, By Age Cohort and Sex

Note: In each of the following charts, the dotted line shows the fitted participation rate trend and projection and the solid line shows the seasonally adjusted participation rate estimate (source: cat. no. 6260.0).

CHART 1. 15 TO 19 YEARS OLD

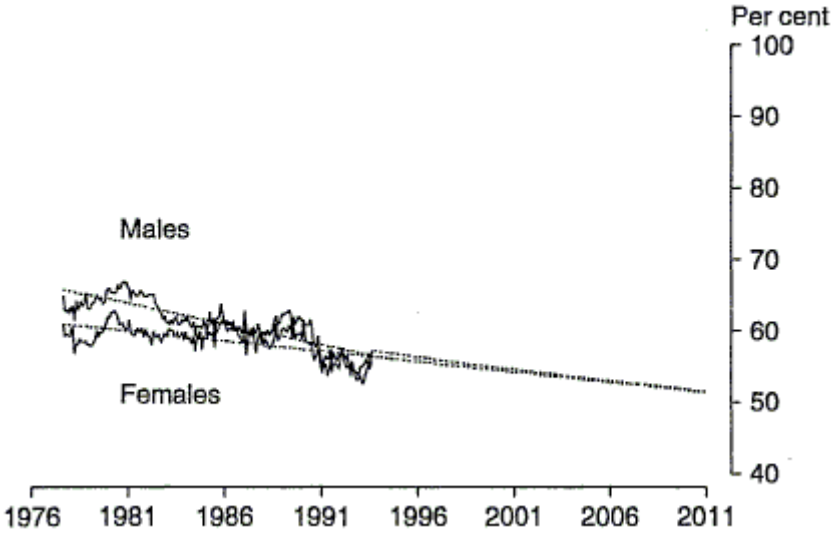


CHART 2. 20 TO 24 YEARS OLD

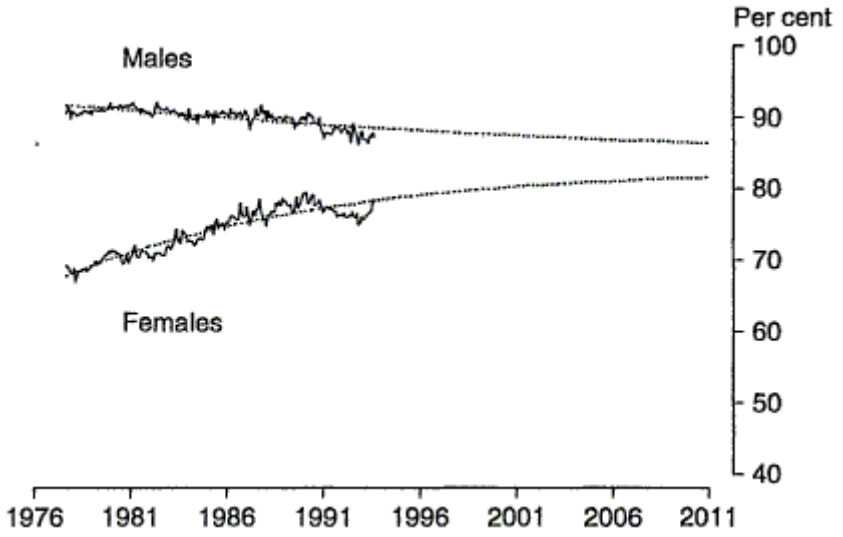


CHART 3. 25 TO 34 YEARS OLD

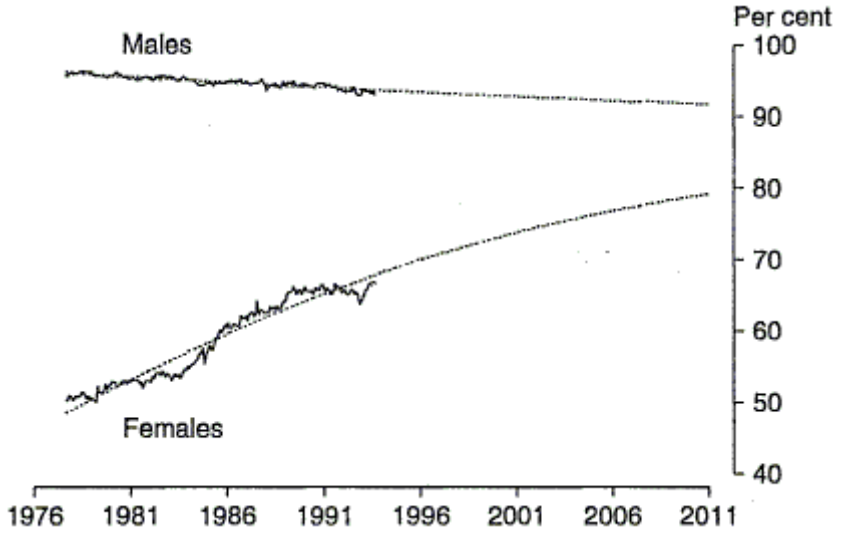


CHART 4. 35 TO 44 YEARS OLD

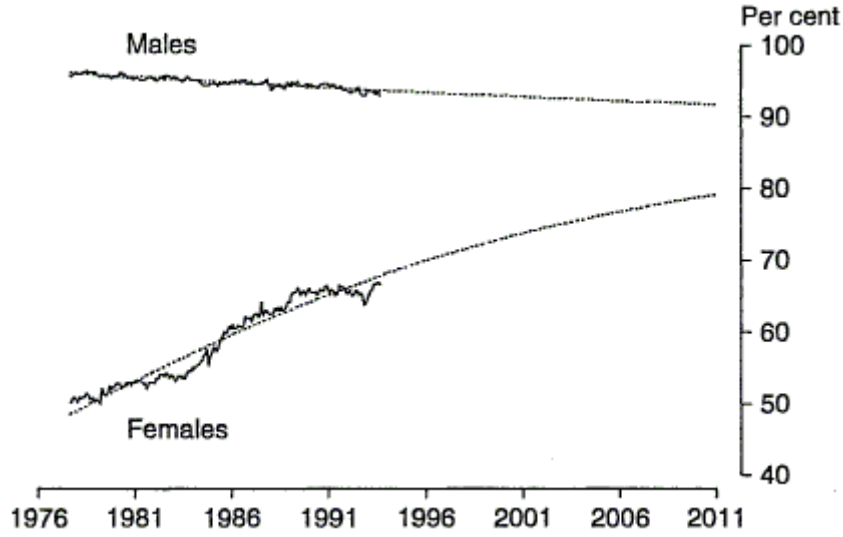


CHART 5. 45 TO 54 YEARS OLD

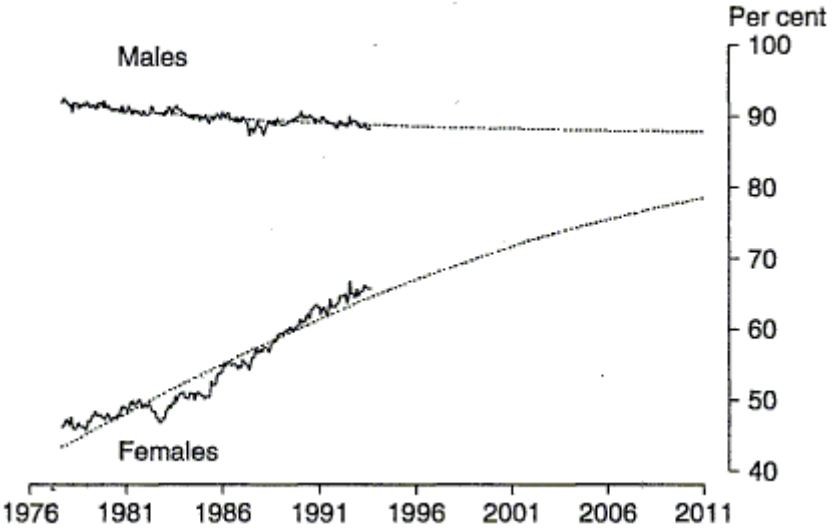


CHART 6: 55 TO 59 YEARS OLD

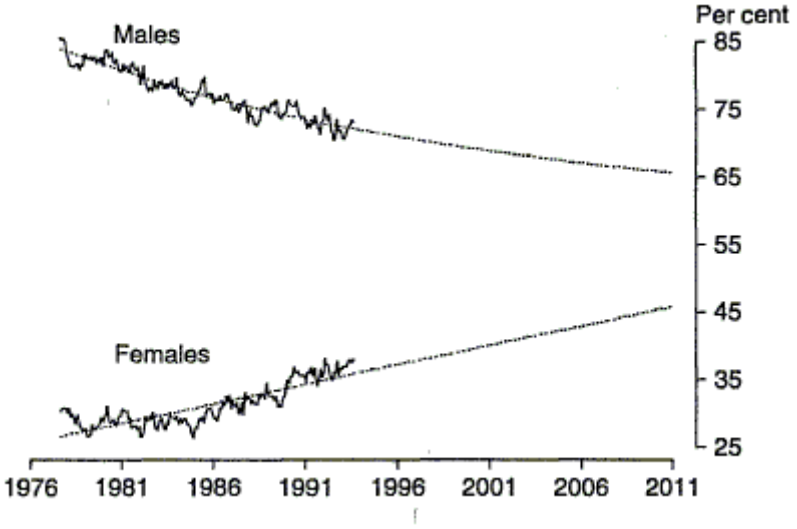


CHART 7: 60 TO 64 YEARS OLD

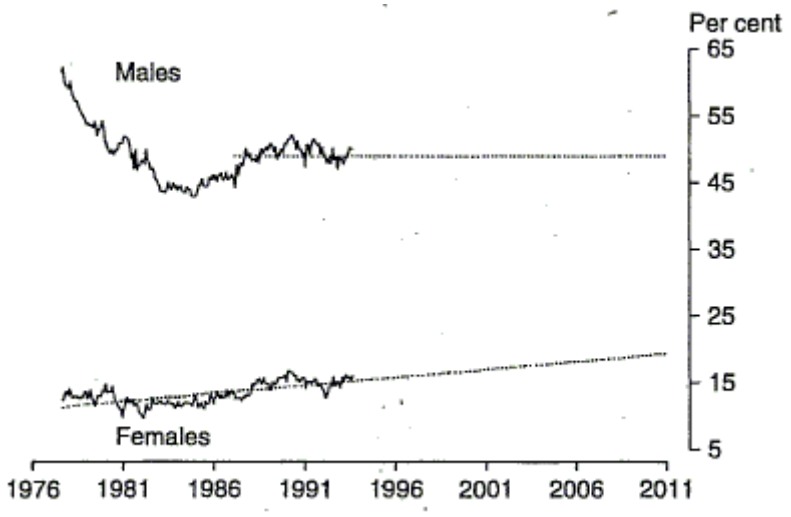
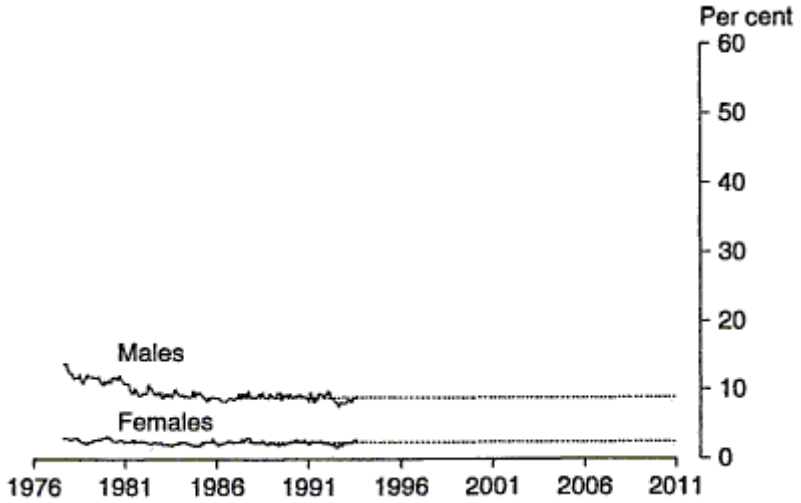


CHART 8: 65 YEARS AND OVER



The sex ratio, the ratio of male to female participation, was therefore used to adjust the male trend. Non-linear least squares estimation was used to fit the logistic regression equation to the sex ratio:

$r_t = 1 / (1 + a.b^T) + e_t$

where
r_t is the sex ratio in time period t;
T is a linear time trend;
e_t is the residual in time period t; and
a,b are the parameters to be estimated;

The sex ratio is thus constrained from falling below unity. The fitted values of the ratio are then multiplied by the projected female participation rate trend to produce a male trend projection that tapers over time to equal the female trend.

A number of factors have contributed to declining teenage labour force participation. Increased

education retention is often cited as an important explanation for the decline. It should be noted, however, that increased education participation is likely to account only for a fall in full-time labour force participation. Part-time participation will tend to increase as education retention rates increase.

When examining the data for the 15-19 age cohort, it was noted that the recent accelerating decline in labour force participation may be attributable to the 1990-91 economic recession. Chart 1 shows that there was a significant fall in both male and female participation in 1991 . Therefore the question arises as to whether participation rates will recover to pre-recession levels.

The current trend line is slightly above the current level of participation, suggesting that teenage male and female participation rates may recover slightly in the short term - before continuing the moderate rate of decline that is projected for the longer term. This teenage labour force scenario is broadly consistent with the one presented by the Department of Employment, Education and Training in the publication Australia's Workforce in the Year 2001 (1991) which suggested that male rates would decline and females rates would remain stable.

Prime Age Cohorts 20-24, 25-34, 35-44, and 45-54 Years Old

In all of these cohorts, when a linear trend is derived for female participation it is observed to exceed or nearly exceed the slowly declining male linear trend within the projection horizon. Thus linear trend projections conflict with the expectation that female participation should not exceed male participation within any given age cohort. It was decided, therefore, to fit logistic trends to.the data, employing the simultaneous non-linear least squares method to estimate male and female trends simultaneously.

The logistic method ensures that the male and female participation rate projections will converge, but not intersect, within the time horizon. In general, the male logistic projections are only slightly higher than the male linear projections. However, the female logistic projections exhibit quite significant tapering relative to linear projections. Thus most of the adjustment to a common limiting value seems to be borne by the female projections.

It is interesting to note that the strong increases in labour force participation observed over the last 15 years for all female cohorts show indications of tapering off, (see Charts 2 to 5). Some of the recent decline is likely to be the result of fewer employment opportunities. However, as the female participation rates approach internationally observed maxima and the corresponding male rates, it may be expected that the observed growth rates will become less dramatic **(footnote 4).** The projections based on logistic trends are consistent with this expectation.

When examining female participation in these age cohorts a regular cycle seems to be present in the data. The growth in participation seems to rise and fall in line with business cycle movements. This would seem to suggest that there is a discouraged worker effect operating in these groups. That is, as unemployment rises females are discouraged from seeking work and leave the labour force (see Charts 2 to 4).

Interestingly, the participation for 45-54 year old females participation did not fall with the 1990-91 recession, perhaps indicating that this group's behaviour is more resistant to deteriorating labour market conditions. The incidence of long term unemployment peaks for females in the 40-44 and 45-49 age cohorts**footnote 5)**. This suggests that these females tend to remain in the labour force, despite losing their job and facing poor employment opportunities.

55-59 Years Old

The linear trend was found to provide a satisfactory fit to the data for the 55-59 female cohort.

The data pointed to a strongly increasing trend in this group.

The 55-59 and 60-64 female cohort's participation did not decline with the recent recession. The factors discussed to explain similar behaviour in the 45-54 females may well apply to these female age cohort. However, female participation in older age cohorts is significantly less than male participation, indicating that older females are generally less attached to the labour force. It is likely that those older females attached to the labour force are robustly attached and therefore less affected by discouraged worker phenomenon.

A logistic trend was fitted to the male participation rates for this age cohort, resulting in a more gradual decline than suggested by the linear approach The logistic trend was preferred because of doubt over the likelihood of a continuing strong decline in participation in this cohort. The superior statistical fit of the logistic trend confirms the logic of this decision (see Chart 6).

A number of influences may combine to determine future changes in both male and female labour force participation for this age cohort. Influences include changes in the tax treatment of retirement income, discouraged worker effects, and structural and technological change **(footnote 6).**

60-64 years and 65 years and over

A linear trend was used for the 60-64 female cohort and it produced a moderately increasing trend projection.

The linear trend fitted to male participation rates for the 60-64 cohort was considered inappropriate. In-stead, the average participation rate calculated over the period August 1987 to February 1994 was used to project a future constant rate (see Chart 7). The resultant rate of 48.8 per cent is consistent with international experience.

The dramatic decline in male participation rates in the early 1980s, which was subsequently reversed, makes this a very difficult cohort for trend analysis. Much of the temporary decline can be attributed to increased entitlements to war service pensions **(footnote 7).**

The male and female participation rates for the 65 years and over cohort were assumed to stabilise at a constant rate (see Chart 8). Therefore the average participation rates calculated over the period August 1986 to February 1994 were used. Linear regression results suggest declining trends for males and females, although there is evidence that the rates have stabilised in recent years. Therefore the constant rate assumption appears appropriate. The abolition of compulsory retirement in some States may impact upon older cohorts participation. This possibility was considered when projecting older cohorts participation. However, as the effect has not yet been observed in the data no adjustments were made to the projections.

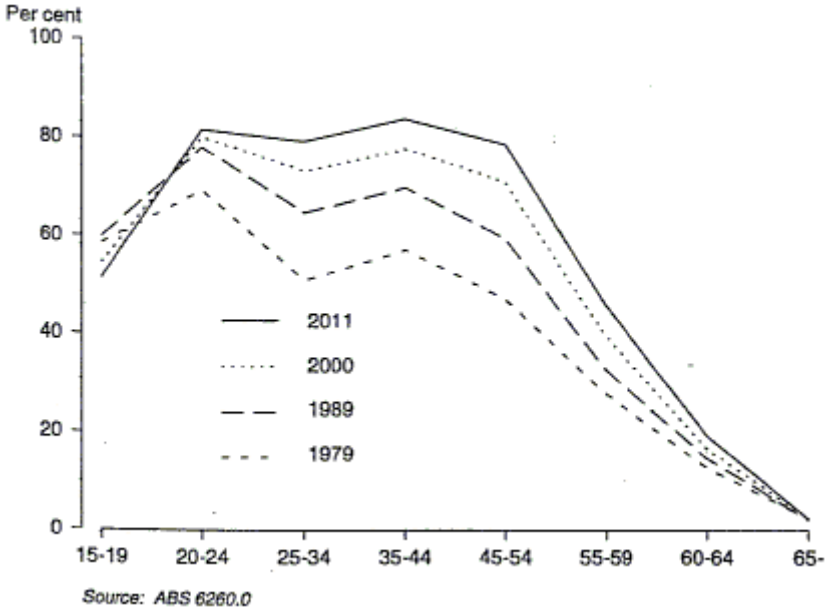
LIFE CYCLE PROFILES

Life cycle profiles of males and females summarise the effect of changes in labour force participation rates for all age cohorts. Life cycle profiles can be presented in two ways; they can follow an age cohort through time, or they can present a snapshot of all age cohorts at a particular point in time. Both presentations are useful for evaluating the effect of projections upon lifetime labour force participation. This discussion concentrates on the snapshot view of the life cycle profile.

The female profile has, in the period 1978 to 1993, changed quite dramatically (see Chart 9). Female labour force participation has been rising in all age cohorts except 15-19 year olds where there has been a small decline. The largest increases were in the 25-34, 35-44, and 45-54

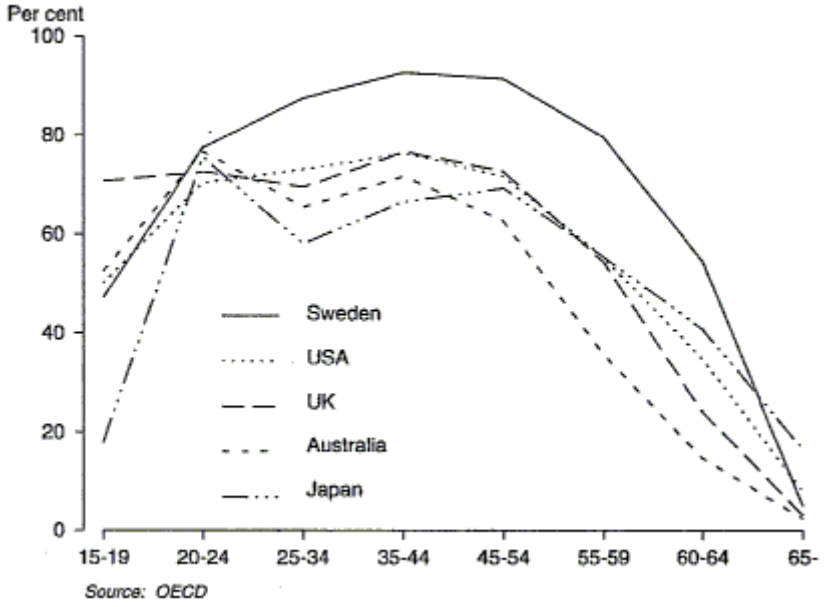
cohorts. Different rates of change across cohorts have changed the shape of the female life cycle profile.

CHART 9. FEMALE LIFE CYCLE , AUSTRALIA



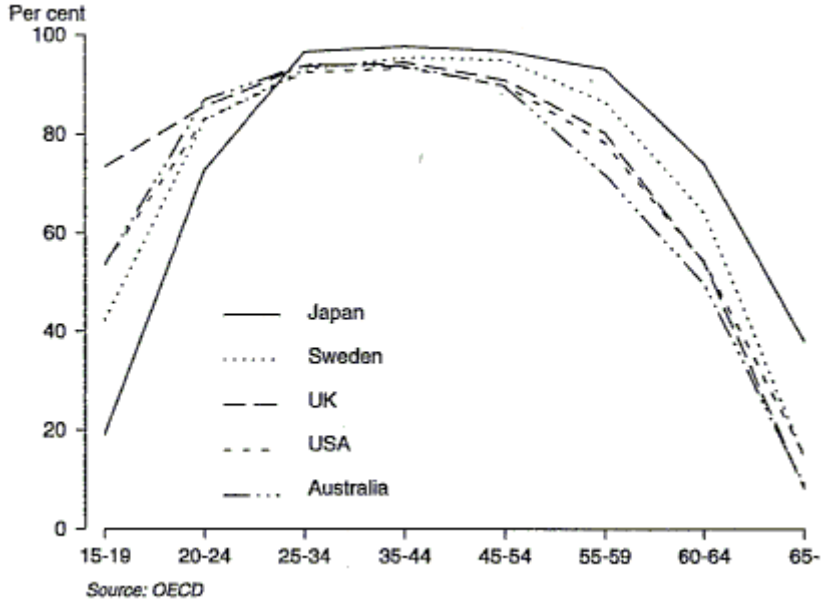
Historically the female profile has taken on an M shape. The M shape is assumed to be a result of females leaving the work force to have children and returning to the work force at a later stage. Our projections continue the trend of the female life cycle losing its M profile. This is consistent with the experience in Sweden, for example, where the female profile does not have an M shape. Chart 10 shows how Australia's female life cycle compared with Sweden, Japan, USA and UK in 1991.

CHART 10. INTERNATIONAL COMPARISON, FEMALE LIFE CYCLES, 1991



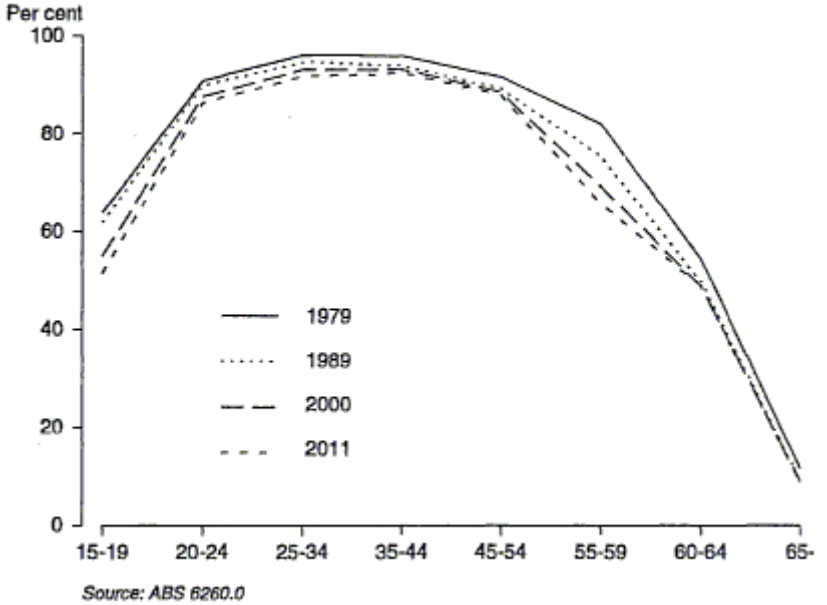
International comparisons indicate that the shape of the Australian male life cycle was not unlike those of Japan, USA, UK, and Sweden in 1991 , see Chart 11.

CHART 11. INTERNATIONAL COMPARISON, MALE LIFE CYCLES, 1991



The male life cycle profile, unlike the female profile, has not changed as dramatically in recent times. In the period 1978 to 1993 labour force participation fell in all male age cohorts. The greatest falls were in the 15-19 and 55-59 age cohorts. The male projections tend to modify the fall in these age cohorts resulting in a profile in 2011 not unlike the 1993 profile, see Chart 12. The largest difference between the 1993 and 2011 male profiles was in the 55-59 year olds. Despite moderating the implied linear trend fall in the 55-59 age cohort the 2011 profile contained a small downward kink at this age cohort. The kink is a projection of the continuation of the move to early retirement amongst males.

CHART 12. MALE LIFE CYCLE, AUSTRALIA



CONCLUSION

The latest participation rate projections have produced some interesting results which tend to conform with general expectations about how the Australian labour force will change over the next 15 years. Female participation rates are projected to continue to increase with moderation in these increases occurring in prime age cohorts. Participation rates in male cohorts are projected to continue to decline moderately. Though the aggregate participation rate changes little over this

time, there is considerable change at a disaggregated level. The changes hold implications for the structure of labour force and how it operates.

However, when projecting out to 2011, at best one can expect to capture the general direction of change. Even this can prove quite difficult, as seen in the 15-19 cohort. Therefore care should be taken in interpreting the results of this exercise.

This feature article was contributed by Steven Kennedy, ABS.

References

Anderson M. and Ross B. (1987), “Labour Force Projections and Tables of Working Life: A Preliminary Investigation”, Paper to the 16th Conference of Economists, August

Australian Bureau of Statistics (ABS) The Labour Force, Australia (ABS cat. no. 6203.0)

ABS Labour Force Projections, Australia, 1992-2005 (ABS cat. no. 6260.0)

ABS Australia’s Long-Term Unemployed: A Statistical Profile (ABS cat. no. 6255.0)

ABS Projections of the Populations of Australia, States and Territories 1993 to 2041 (ABS cat. no. 3222.0)

Committee on Employment Opportunities (1993) Restoring Full Employment: A Discussion Paper.

Department of Employment, Education and Training (1991) Australia’s Workforce in the Year 200l, AGPS, Canberra.

Dunlop Y, Healy T & McMahon P.J. (1984) “Australian Models of Labour Force Participation: A Critical Review”, in Labour Force Participation in Australia, Kaspura.A.J. (ed.). Bureau of Labour Market Research, AGPS, Canberra.

Merrilees, W.J. (1982) The Mass Exodus of Older Males from the Labour Force: An Exploratory Analysis. Australian Bulietin of Labour 8 (2) 81 -94

OECD (1992) Labour Force Statistics 1970-1990. OECD, Paris. V

OECD (1987) Employment Outlook. September. OECD, Paris.

United Kingdom Department of Employment (1993) “Labour Force Projections: 1993-2006” , Employment Gazette, April, pp. 139-147.

United States Department of Labor, Bureau of Labor Statistics (1992) BLS Handbook of Methods. US Government Printing Office, Washington, D.C.

United States Department of Labor, Bureau of Labour Statistics (1993) “Another Look at the Labor Force”, Monthly Labour Review, November, pp 31-39.

Footnotes

(1) This article draws on sections of the methodological appendices contained in Labour’ Force Projections, Australia 1995-2011 (ABS cat. no. 6260.0). For a more complete explanation of the methodological basis of the labour force projections see these appendices. **Back**

(2) The 1991 labour force projections publication contains a discussion of the development of labour force projections at the ABS. Issues surrounding the use of econometric modelling versus univariate time series techniques to project participation rates were explored. The discussion concluded that univariate time series techniques represented the most appropriate approach for the ABS at that time. The key arguments supporting this conclusion included the cost effectiveness of the univariate techniques and the failure of econometric models to produce significantly superior results. These arguments have been accepted for the current projections as no contrary evidence has come to our attention. These arguments are supported in a paper by Dunlop et al (1982) and from an examination of studies by the United States Bureau of Labor Statistics, Statistics New Zealand and the Department of Employment in the United Kingdom. **Back**

(3) Though the monthly participation data was preferred to the longer quarterly data, the quarterly data did prove quite useful in analysing this cohort. An examination of the quarterly data shows that the participation rate for the 15-19 male cohort peaked in the period 1978 to 1982, after increasing throughout the 1970s. The strength of this peak appears unusual when compared with recent movements in male and female 15-19 participation rates. Therefore, the male projection was adjusted so as to modify the effect of the peak. **Back**

(4) A similar expectation of the future growth in female rates was expressed in Restoring Full Employment: A Discussion Paper (1993) by the Committee on Employment Opportunities, page 28. **Back**

(5) See ABS Australia's Long-Term Unemployed: A Statistical Profile (ABS cat. no. 6255.0). **Back**

(6) Restoring Full Employment: A Discussion Paper (1993) by the Committee on Employment Opportunities, pp 28-29. **Back**

(7) Merrilees, W.J. (1982) The Mass Exodus of Older Males from the Labour Force: An Exploratory Analysis. Australian Bulletin of Labour 8 (2) 81-94 **Back**

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